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ASPEN HYBRIDS — A FUTURE SOURCE OF LAKE STATES FIBER

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INTRODUCTION

Major increases in hardwood fiber requirements are predicted. Seventy-five percent of the Lake States forest area is classified as hardwoods. Hybrid aspen appears to be an ideal material for use in short rotation, intensive management systems. A maximum fiber production system is under investigation that is expected to involve genetically improved aspen, improved utilization, short rotations and periodic fertilization.

The discussion that follows considers establishment methods, growth rate, harvesting procedures, fertilizer response and wood and pulp quality of hybrid aspen. Conversion of low-quality northern hardwood stands to hybrid aspen appears to offer considerable promise as an inexpensive method of increasing fiber yield.

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Hardwood Fiber Requirements Increase

The Lake States region is primarily a hardwood region with approximately 75% of the forest area classified as hardwoods (1, 2, 3). Projections of population changes, per capita paper and board consumption, land use trends, and environmental pressures make it increasingly clear that Lake States hardwood fiber will be in short supply soon after the year 2000 (3, 4).

Maximum Production Required

There are a number of ways of increasing hardwood fiber production in the Lake States region. Because of the large increases required, it appears the gains possible by a single approach will not be adequate to meet future demands. Systems that employ a combination of approaches (genetics, intensive management, improved utilization, etc.) are required. Lake States aspen, because of its rapid growth, suckering ability, ability to grow on upland sites, ease of harvesting, bark characteristics, and wood quality, appears to be an ideal species for use in short rotation, intensive management systems. Aspen hybrids are also available that are expected to grow about 200-cubic feet/acre/year, about twice as fast as native aspen, on upland low-quality northern hardwood sites. A maximum fiber production system is under investigation at The Institute of Paper Chemistry that is expected to involve a combination of genetically improved trees (hybrid aspen), improved utilization (whole-tree chipping), short rotations (10-20 years), and periodic fertilization. Presently, biological data are being collected that will more clearly establish the magnitude of growth response to intensive forest management techniques. Parent tree arboreta are being established that will enable companies who are members of the cooperative program to produce a total of

1.5 to 2.0 million hybrid aspen/year for planting by 1986. Figure 1 illustrates one-year-old hybrid aspen growing in seedbeds prior to fall lifting.

[Fig. 1 here]

Establishment

Hybrid aspen plantings have been made on both old field sites and on cut-over areas. Most plantings have been established using hand planting techniques; however, in a number of instances where machine planting was employed, early survival was 80-90% and growth was good where vegetative competition was not excessive. Hybrid aspen, like other species of Populus, are sensitive to grass and herbaceous competition and on old field sites require preplanting site preparation and cultivation for the first one-and-a-half years after planting.

Conversion of hardwood stands growing on medium-quality upland oak sites or low-quality northern hardwood sites to aspen hybrids appears to be the most promising approach for the establishment of such material. Late summer, fall, or winter clear cutting followed by windrowing the slash or by whole-tree chipping adequately prepares the site. When the planting is made the first spring after cutting, no further treatment of the vegetation on the area is required. The aspen hybrid seedlings grow at about the same rate as aspen suckers and considerably faster than oak and northern hardwood sprouts. Planting is not recommended where heavy aspen suckering is anticipated, unless herbicides are used to control the suckers prior to planting. Figures 2 and 3 illustrate conversion plantings located in Wisconsin and Michigan. Early survival of conversion plantings has been good (70-90%), growth has been very good and establishment costs low. Present recommendations are to plant 400-500 hybrids/acre and grow the trees to pulpwood size or larger. Upon harvesting, the rapid-growing hybrid sucker stand that results can easily be used in a short rotation intensive management

system or the suckers handled by less intensive procedures for the production of solid wood products and pulpwood.

[Fig. 2 and 3 here]

Harvesting

Aspen, because of its uniform size, straight form, good natural pruning, and occurrence in stands with larger numbers of stems/acre, is well suited to mechanical harvesting techniques. High rates of production are obtainable by whole-tree chipping and tree-length harvesting systems. Clear cutting of aspen hybrids, because of the suckering ability of aspen, is expected to result in a mixture of clones¹ with the suckers from the most vigorous seedlings taking over the area. Careful use of clear-cutting² techniques will mean that from a single planting cost and with the help of natural selection, a mixture of vigorous hybrid clones can be established and maintained on an area. Figure 4 illustrates a northern Wisconsin 16-year-old hybrid aspen plantation and an 11-year-old hybrid aspen sucker stand that are both growing at about 200 cubic feet/acre/year.

[Fig. 4 here]

Intensive Management

Studies investigating the feasibility of fertilization and irrigation indicate growth response can be expected to vary considerably from site to site for upland soils in the Lake States region. Available soil moisture is the most important variable influencing fertilizer response. Volume growth from "fertilizer only" treatments has varied from 10-50%. Response has been lowest on very sandy

¹A group of genetically identical trees arising from the root system of a single seedling.

²Clear cutting must be used with care and is not recommended where, because of topography, site deterioration will result from erosion.

soils where available soil moisture is low and becomes limiting at certain times during the growing season. Greatest response is expected on low fertility sites with good soil moisture levels. Volume growth increases of 100 to 140% have been obtained when both water and fertilizer has been added. Aspen hybrid plantings have given greater response than nature aspen sucker stands and plantings of native aspen seedlings.

Wood Quality

Aspen, despite being a relatively short-fibered (± 1.0 mm) hardwood, is suitable for use in a number of types of solid wood products (5), makes good quality groundwood, and can be profitably pulped by most chemical and chemical-mechanical procedures (6). One concern often expressed is that the rapid-growing aspen hybrids will have less desirable wood density and fiber properties than the native aspen. This, however, does not appear to be true. One of the hybrids has been extensively investigated and Table I illustrates that this particular hybrid, which grows about twice as fast as normal aspen, has longer fibers, higher specific gravity, and produces a pulp that is higher in tear and tensile strength than native aspen (7).

[Table I here]

Recommended Use

Aspen hybrids are recommended for use on upland medium-quality oak and low-quality northern hardwood sites in the Lake States region. Conversion plantings using a heavy-duty tree planter or hand planting the first spring after the site has been cleared by a whole-tree chipping operation will minimize cost and assure 80-95% survival, good early growth, and 400-450 trees/acre. Planting is not recommended where heavy suckering of good quality aspen is anticipated. Growth

after 15-18 years with 450 trees/acre can be expected to range from 150 to 200 cubic feet/acre/year, depending upon the site quality. The use of fertilization procedures 3-5 years before harvest can be expected to increase the growth rate an additional 20-40%, the degree of response depending upon the available soil moisture.

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Table 1. Comparison of wood and kraft pulping properties of triploid hybrid aspen

Type of material	Wood specific gravity, g/cc	Pulp fiber length, mm	Screened pulp yield, %	Handsheet properties ^a		
				Tear	Burst	Tensile
Mature native aspen	0.349	0.91	52.6	75.7	51.5	10.3
15-Year-old native aspen	0.350	0.79	52.1	73.0	48.0	9.9
10-Year-old triploid hybrid aspen	0.420	0.94	53.5	88.0	55.7	10.1
15-Year-old triploid hybrid aspen	0.401	1.00	51.2	96.0	58.0	10.4

^aMeasurements at 750-ml Schopper-Riegler freeness, tear and burst are TAPPI factors, tensile is breaking length in km.



Figure 1. One-year-old hybrid aspen seedbeds at The Institute of Paper Chemistry nursery. Trees will be lifted in the fall, root pruned and cut back to 14-16 inches prior to field planting.



Figure 2. "Alba x bigtooth" hybrids near 15 feet in height during summer of fourth year. Hybrids were planted on a cut-over northern hardwood site near Tomahawk, Wisconsin.

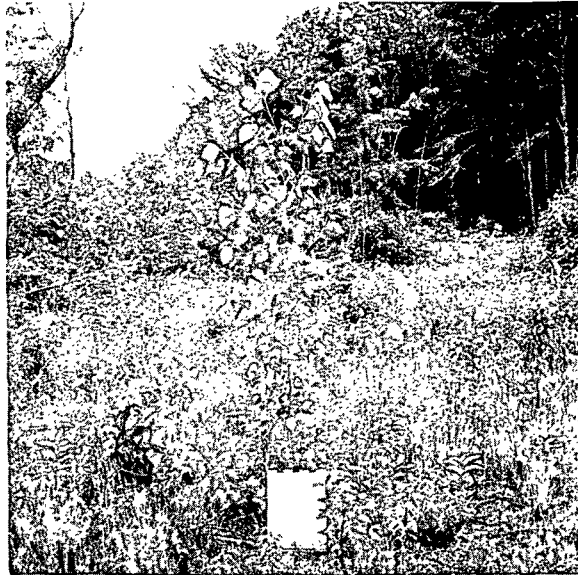


Figure 3. "Canescens x bigtooth" hybrid growing on a clearcut northern hardwood site near Mesick, Michigan. Tree is 6 feet in height and is in the spring of the second growing season.

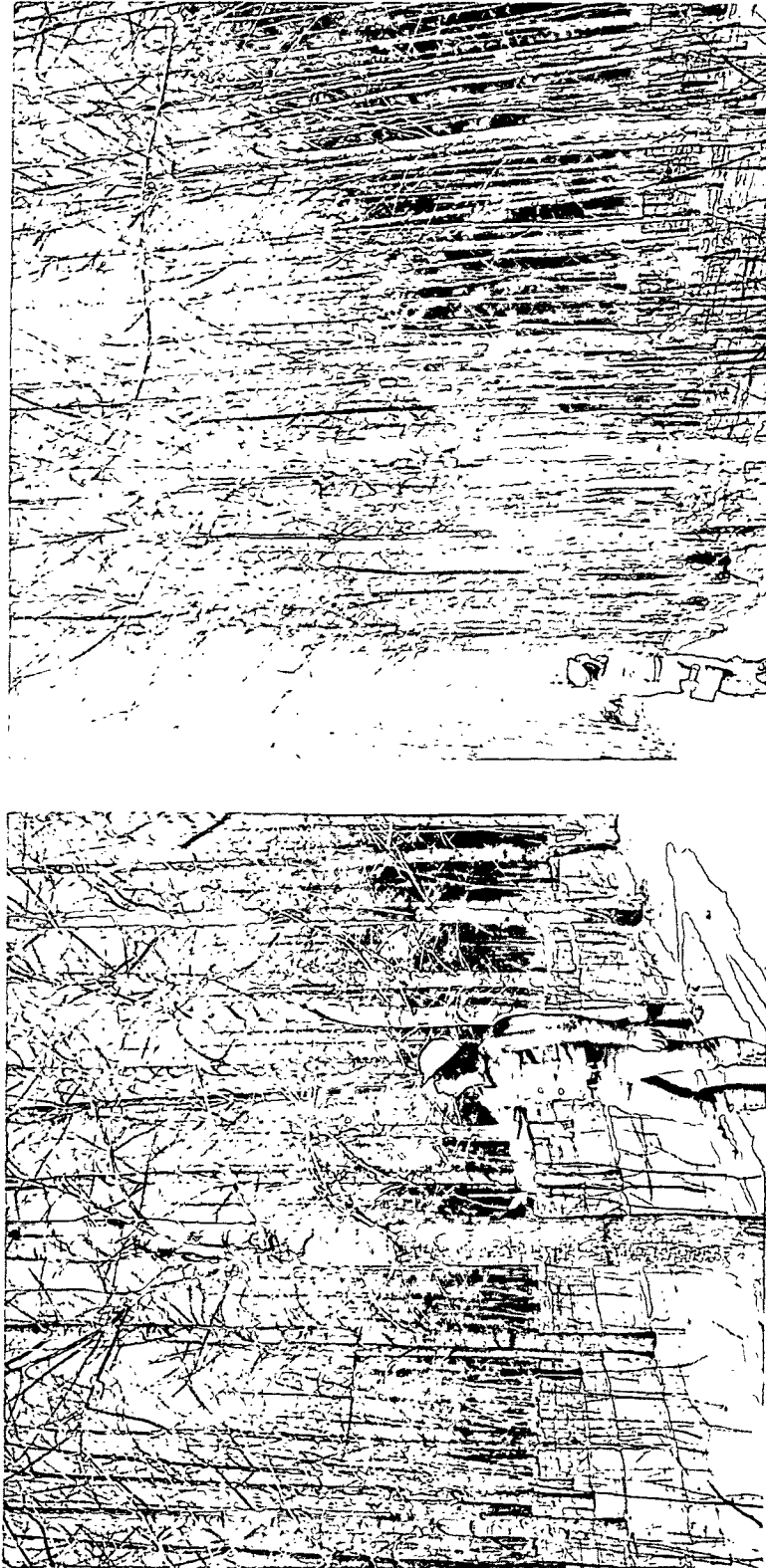


Figure 4. Triploid hybrid aspen growing in northern Wisconsin. Picture on the left illustrates 16-year-old plantation trees while the picture on the right illustrates an 11-year-old sucker stand formed after cutting back plantation trees at age five. Presently, the growth of both stands is about 200-cubic feet/acre/year.